

N64-33218

(ACCESSION NUMBER)	(THRU)
42	/
(PAGES)	(CODE)
10ASA CR59186	82
(NASA CR OR TMX OR AD NUMBER)	(CATEGORY)

FACILITY FORM 802

OTS PRICE

XEROX \$ 2.00
MICROFILM \$.50

WT 21-148

FORCE TEST OF A COLD-WALL BLUNT-
NOSE CYLINDER-FLARE MODEL IN AIR-
CARBON-DIOXIDE MIXTURES IN THE
JPL 21-INCH HYPERSONIC
WIND TUNNEL

Robert B. Blaylock

Robert E. Covey
Robert E. Covey, Chief
Aerodynamic Facilities Section

JET PROPULSION LABORATORY
CALIFORNIA INSTITUTE OF TECHNOLOGY
PASADENA, CALIFORNIA
March 15, 1964

Copyright © 1964
Jet Propulsion Laboratory
California Institute of Technology

Prepared Under Contract No. NAS 7-100
National Aeronautics & Space Administration

CONTENTS

I.	Introduction	1
II.	Model Description	1
III.	Wind Tunnel and Instrumentation	1
IV.	Test Procedure	2
V.	Data Reduction	2
VI.	Results	3
	Nomenclature	4
	References	5
	Figures	
	Plots	

FIGURES

1. Dimensions and installation of model
2. Sign conventions

PLOTS

Plot No.	Run No.	ALPHA (deg)	P _t (cm Hg)	T _t (°F)	Mach No.	Re (10 ⁻⁵)
1	3	-5	990	1298	6.6	0.74
	17		996	1296	6.1	0.68
	29		1000	1296	5.7	0.80
2	36		1000	1295	5.5	0.87
	4	-3	996	1297	6.5	0.74
	18		999	1296	6.1	0.68
3	41		999	1294	5.9	0.75
	50		1004	1294	5.7	0.82
	5	-1	998	1297	6.6	0.74
4	19		998	1296	6.1	0.69
	51		980	1294	5.9	0.71
	45		999	1296	5.6	0.84
4	2	0	1000	1296	6.5	0.74
	3		990	1297	6.5	0.74
	15		992	1294	6.5	0.73
	16		990	1296	6.1	0.68
	20		994	1295	6.2	0.69
	27		1000	1293	6.2	0.71
	28		999	1296	5.8	0.82
	49		1000	1294	5.8	0.74
	40		998	1294	5.5	0.86
	44		1004	1296	5.7	0.87
5	7	1	1000	1298	6.6	0.74
	21		1001	1296	6.2	0.69
	46		998	1296	5.6	0.83
6	8	3	997	1298	6.6	0.74
	22		999	1297	6.2	0.68
	52		985	1294	5.7	0.71
7	47		996	1292	5.6	0.83
	9	5	998	1298	6.6	0.74
7	14	5	1000	1295	6.5	0.73

PLOTS (Cont'd)

Plot No.	Run No.	ALPHA (deg)	P _t (cm Hg)	T _t (° F)	Mach No.	Re (10 ⁻⁵)
7	23	5	999	1294	6.2	0.69
7	37	5	990	1294	5.4	0.85
8	10	8	1000	1298	6.6	0.74
↓	24	↓	1000	1293	6.2	0.68
↓	48	↓	998	1294	5.5	0.93
9	11	10	999	1295	6.6	0.74
↓	25	↓	997	1293	6.1	0.68
↓	38	↓	990	1295	5.5	0.84
10	12	15	1000	1295	6.6	0.74
↓	26	↓	997	1293	6.3	0.71
↓	39	↓	998	1294	5.6	0.86

I. INTRODUCTION

Wind-tunnel Test 21-148 was a test of a blunt nose-cylinder-flare model. The purpose of the test was to investigate the effect of model wall temperature to free-stream stagnation temperature ratio on aerodynamic coefficient in carbon-dioxide air mixtures. The approximate aerodynamic parameters for the test were a Mach No. 6.5 and Reynolds No./in. of 0.74×10^5 in air. The test variables and ranges were angle of attack from -5 to 15 deg and model wall temperature to free-stream stagnation temperature ratio from 0.09 to 0.7.

The model configuration comprised a blunt nose and a cylinder with a flare. Forces and moments were obtained for the complete configuration.

The test¹ was conducted at the Jet Propulsion Laboratory (JPL) from June 24 through 28, 1963.

II. MODEL DESCRIPTION

The model is shown in Fig. 1. The model was a copper shell with an insulating insert of "Mykroy"² used between the model and the balance. Four thermocouples were located in the model to check uniformity of cooling.

III. WIND TUNNEL AND INSTRUMENTATION

Reference 1 describes the construction and operating conditions of the 21-in. hypersonic wind tunnel. The wind tunnel has a nominal test-section size of 21 in. square, a Mach range from 4 to 11 in air, a flexible-plate nozzle, and operates with continuous flow. The operation of this tunnel with carbon dioxide (CO_2) air mixtures as a working fluid is described in Ref. 2.

A six-component, internal, strain-gage balance was used to measure force-and-moment data.

¹The symbols used in this Report are defined in the Nomenclature.

²Trade name for a glass-mica mixture produced by Molecular Dielectrics, Inc.

Temperatures were recorded by a continuous operating system which converted all thermocouple outputs to a digitized signal.

IV. TEST PROCEDURE

Prior to actual test operations, measurements were made to determine the position of the model, the deflection constants, and the balance tares. During the test, data points were obtained at successive values of model wall temperature.

V. DATA REDUCTION

The force-and-moment data were reduced to dimensionless coefficients. The coefficients were obtained as follows:

$$\text{force coefficient} = \frac{\text{force}}{q A}$$

$$\text{moment coefficient} = \frac{\text{moment}}{q Ad}$$

where

q = free-stream dynamic pressure (psi)

A = reference area = 5.939 (in.²)

d = reference length = 2.750 (in.)

and the point about which the moments were measured was 3.3345 in. from the model nose, on the model centerline.

The free-stream dynamic pressure was calculated from measured values of free-stream static and dynamic pressures by a semiempirical approximation to real gas tables (Ref. 3).

The coefficients were obtained on a digital computer by a standardized series of formulas as indicated in Ref. 4.

The coefficients are defined in the Nomenclature, and the coefficient sign conventions are shown in Fig. 2.

The repeatability of the coefficients is as follows:

$$CN = 0.01$$

$$CC = 0.004$$

$$CMCG = 0.01$$

VI. RESULTS

The results of this test have been reduced to dimensionless coefficients and are presented in Plot Series 1a-c through 10a-c. No attempt was made in this Report to interpret the results.

NOMENCLATURE

A	reference area (cross-sectional area of cylinder), in. ²
CC	dimensionless aerodynamic chord-force coefficient in the body axis system; (body axis system: an orthogonal-coordinates system which is always parallel and perpendicular to the axis of symmetry of the model body)
CMCG	dimensionless aerodynamic pitch-moment coefficient in the body axis system
CN	dimensionless aerodynamic normal-force coefficient in the body axis system
d	reference length (cylinder diameter), in.
M	Mach number
P _t	wind-tunnel stagnation pressure, cm Hg
q	free-stream dynamic pressure, psi
Re	Reynolds number per inch
T _t	wind-tunnel stagnation temperature, °F
TW/TT	model wall temperature to wind-tunnel stagnation temperature ratio
ALPHA	angle of attack, deg
%CO2	percent carbon dioxide (CO ₂) in working fluid

REFERENCES

1. Jet Propulsion Laboratory, California Institute of Technology. Wind-Tunnel Facilities at the Jet Propulsion Laboratory. Pasadena, California, JPL, 18 April 1961. (Technical Release No. 34-257) UNCLASSIFIED
2. Jet Propulsion Laboratory, California Institute of Technology. The Use of a Conventional Wind Tunnel as a Multigas Facility, H. Koester, G. Herrera, and D. Hanks. Pasadena, California, JPL, 8 April 1963. (Technical Memorandum No. 33-145) UNCLASSIFIED
3. Ames Research Center. Private Communication: Victor L. Peterson (Ames) and Robert B. Blaylock (JPL). Moffett Field, California, Ames, June 1963. (Oral Communication) UNCLASSIFIED
4. Jet Propulsion Laboratory, California Institute of Technology. Equations for Wind-Tunnel-Force Data Reduction. Pasadena, California, JPL, 19 April 1957. (Internal Memorandum SWT G-T3) UNCLASSIFIED

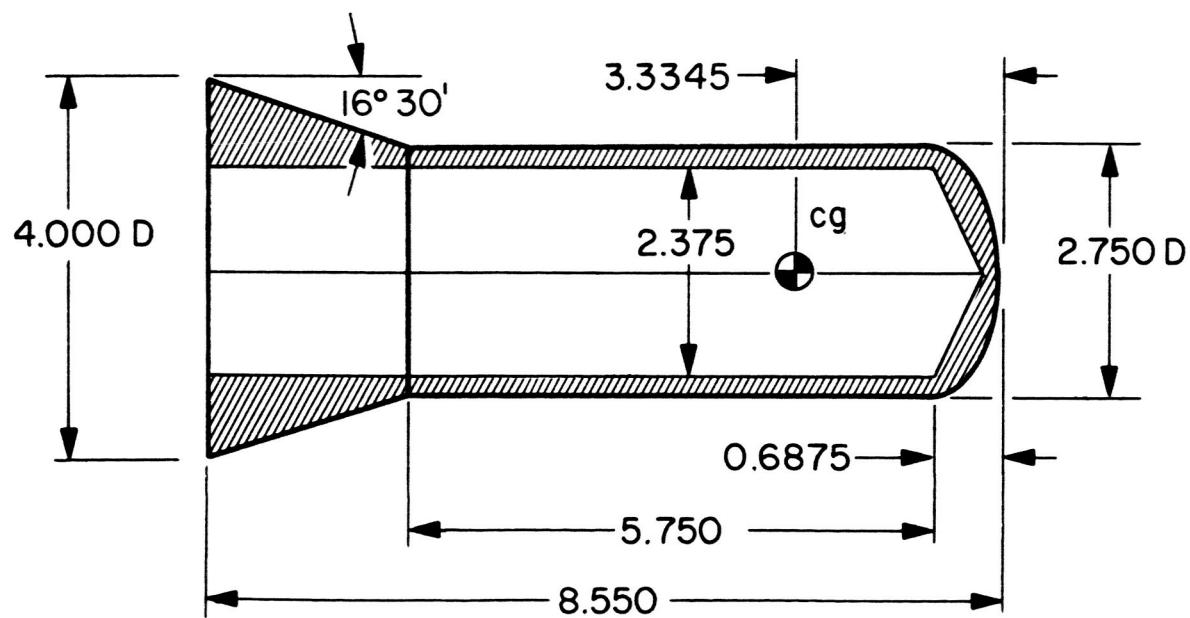
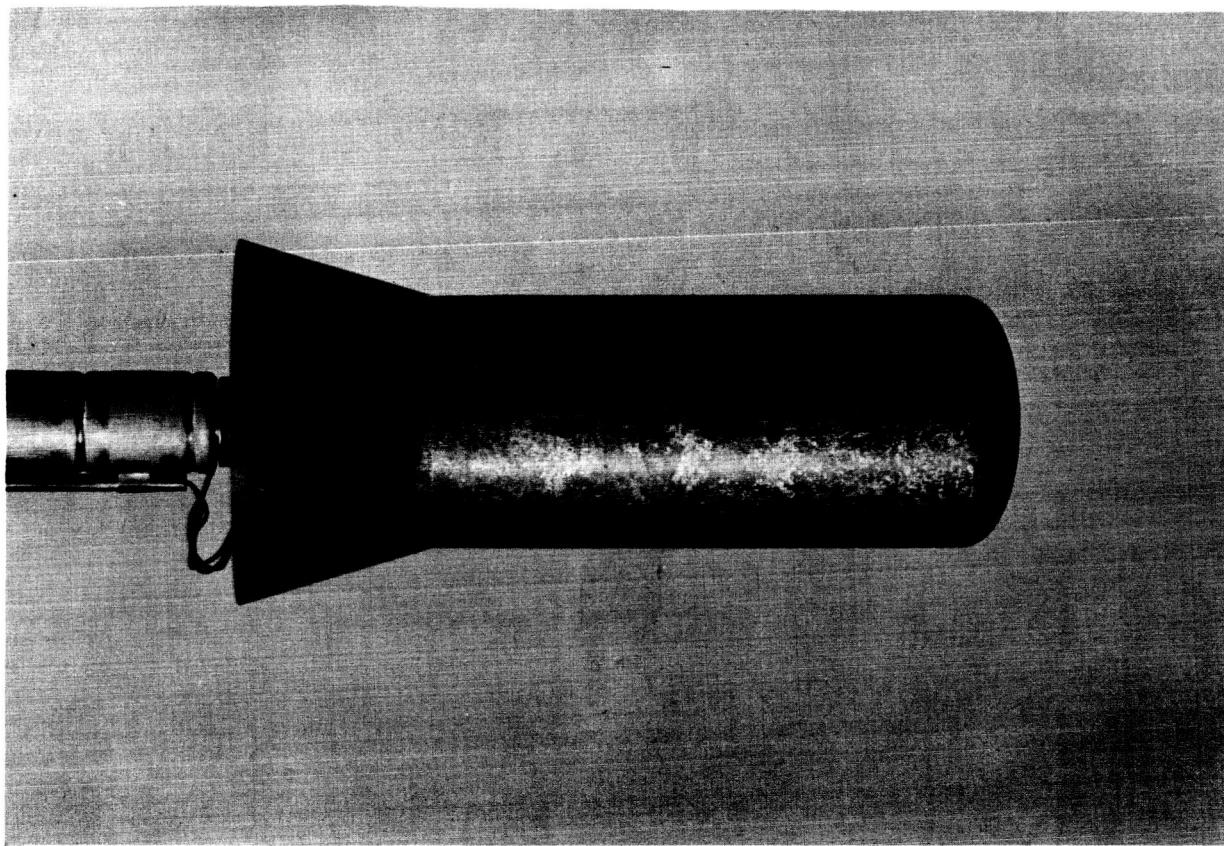
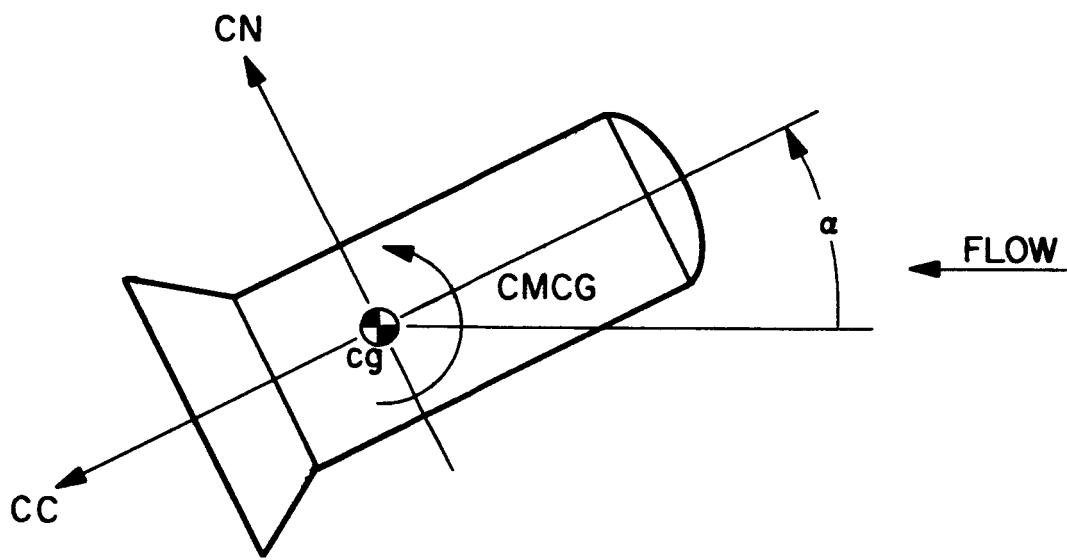


Fig. 1. Dimensions and installation of model



NOTE:
ARROWS INDICATE
POSITIVE DIRECTIONS OF
ATTITUDE ANGLES, FORCES,
AND MOMENTS

Fig. 2. Sign conventions

